METHOD AND APPARATUS FOR PROVIDING A SERVICE THRESHOLD INDICATOR IN A WIRELESS COMMUNICATION SYSTEM

BACKGROUND

Field

[1001] The present invention relates generally to communication systems, and, more specifically, to a method and apparatus for providing a service threshold indicator in a wireless communication system employing a broadcast and multicast communication service (BCMCS).

Background

[1002] Broadcast and multicast services provide point-to-multipoint communication service in a wireless communication system between at least one base transceiver site and a plurality of access terminals that receive the broadcast data within the communication coverage area of the base transceiver site. The broadcast data (i.e., content) transmitted by the base transceiver site to the plurality of access terminals may include, but need not necessarily be limited to, news, movies, sporting events, and the like. The content is typically generated by a content server and is broadcast to the access terminals that subscribe to the service over a forward broadcast shared channel (F-BSCH).

[1003] To authenticate the access terminal for receiving the particular content subscribed to, the content server or BCMCS controller, which resides in a network of a system operator of the wireless communication system, will typically generate a value of a Broadcast Access Key (BAK) over an overhead channel to the access terminals. The BAK serves as a security association between the content server and the group of access terminals that subscribe to certain services provided by the content server.

[1004] Typically, a system operator of the wireless communication system will charge the access terminal's user when he or she obtains the BAK for content that is generated by the content server. If the BAK has a relatively short lifetime (e.g., for a minute or a few minutes), for purposes of pay-per-view charging for the content, the access terminal will typically tune to the content on the F-BSCH subsequent to receiving the BAK. In some cases, however, the access terminal may move to a

coverage area of the wireless communication system where the radio reception of the access terminal is poor for receiving the content albeit the access terminal may have successfully obtained the BAK over the TCP/IP session. As a result, the access terminal may experience an unacceptable service quality of the content from the content server when the access terminal has tuned to the F-BSCH for receiving the content.

[1005] In another scenario, the lifetime of the BAK received by the access terminal may be longer (e.g., for a month or more) to provide the access terminal with content generated from the content server. As long as the BAK is obtained, the access terminal may receive the content over the F-BSCH. Even though the access terminal may be able to obtain the content over the F-BSCH, however, the content may become corrupted as it is received by the access terminal when the radio reception for the access terminal is deemed poor. As a result, the access terminal may try to decode the corrupted content, thus causing an unnecessary drain on the access terminal's battery.

[1006] In another scenario, the content may be delivered to a group of access terminals that may "playback" the content at a later time after receiving the content. If an access terminal resides in an area with poor radio reception of the wireless communication system, the received content may become corrupted when being received over the F-BSCH. The access terminal may request retransmission of the corrupted content at a later time. In such a case, the unicast (i.e., point-to-point) transmission of the content may be used by the wireless communication system to retransmit the particular content that was not properly received by the access terminal initially. However, if the number of access terminals who desire retransmission of the particular content becomes large, such unicast transmission of the particular content may undesirably increase the load of the wireless communication system, thereby consuming the system's available resources significantly.

[1007] The present invention is directed to overcoming, or at least reducing the effects of, one or more problems indicated above.

SUMMARY

[1008] In one aspect of the invention, a method for a broadcast wireless communication system having a plurality of terminals is provided. The method comprises determining at least one radio frequency (RF) quality requirement defining a minimum quality of communication service threshold for receiving broadcast information by at least one terminal over a broadcast communication channel and associating the at least one RF quality requirement with a service threshold indicator (STI) value. The STI value is communicated to the at least one terminal. At least one RF quality parameter of the broadcast communication channel is determined, where the RF quality parameter defines a degree of quality in which communication is received by the terminal over the broadcast communication channel. The RF quality parameter is compared to the RF quality requirement corresponding to the communicated STI value, and the terminal is prevented from tuning to the broadcast communication channel providing that the RF quality parameter is lower than the RF quality requirement.

[1009] In another aspect of the present invention a method for a broadcast wireless communication system having a plurality of terminals is provided. The method includes communicating a service threshold indicator (STI) value to at least one terminal, where the STI value is indicative of at least one radio frequency (RF) quality requirement defining a minimum quality of service threshold for receiving broadcast information by the at least one terminal over a broadcast communication channel. At least one RF quality parameter of the broadcast communication channel is measured, where the RF quality parameter defines a degree of quality in which communication is received by the terminal over the broadcast communication channel. The terminal is prevented from tuning to the broadcast communication channel providing that the RF quality parameter is lower than the RF quality requirement.

[1010] In another aspect of the present invention, a broadcast wireless communication system is provided. The system comprises at least one transmitter for transmitting broadcast information over a broadcast communication channel and a plurality of terminals. A controller determines at least one radio frequency (RF) quality requirement defining a minimum quality of communication service threshold for receiving broadcast information by at least one terminal of the plurality of terminals over a broadcast communication channel, and associates the at least one RF quality requirement with a service threshold indicator (STI) value. The at least one transmitter

communicates the STI value to the at least one terminal, and the at least one terminal determines at least one RF quality parameter defining a degree of quality in which communication is received by the terminal over the broadcast communication channel. The at least one terminal further compares the RF quality parameter to the RF quality requirement corresponding to the communicated STI value, and prevents the terminal from tuning to the broadcast communication channel providing that the RF quality parameter is lower than the RF quality requirement.

[1011] In another aspect of the present invention, an apparatus for a broadcast wireless communication system having a plurality of terminals is provided. The apparatus comprises means for communicating a service threshold indicator (STI) value to at least one terminal, where the STI value is indicative of at least one radio frequency (RF) quality requirement defining a minimum quality of service threshold for receiving broadcast information by the at least one terminal over a broadcast communication channel. The apparatus further comprises means for measuring at least one RF quality parameter of the broadcast communication channel, where the RF quality parameter defines a degree of quality in which communication is received by the terminal over the broadcast communication channel, and means for preventing the terminal from tuning to the broadcast communication channel providing that the RF quality parameter is lower than the RF quality requirement.

[1012] In another aspect of the present invention, a terminal in a broadcast wireless communication system, having at least one transmitter for transmitting broadcast information to the terminal over a broadcast communication channel, is provided. The terminal comprises a receiver for receiving a service threshold indicator (STI) value, the STI value being indicative of at least one radio frequency (RF) quality requirement defining a minimum quality of service threshold for receiving broadcast information by the terminal over a broadcast communication channel. The terminal further comprises a controller for measuring at least one RF quality parameter of the broadcast communication channel, where the RF quality parameter defines a degree of quality in which communication is received by the terminal over the broadcast communication channel, and preventing the receiver from tuning to the broadcast communication channel providing that the RF quality parameter is lower than the RF quality requirement.

BRIEF DESCRIPTION OF THE DRAWINGS

[1013] FIG. 1 is a block diagram of a wireless communication system including a plurality of access terminals and a radio access network (RAN) that employs a Broadcast and Multicast Service (BCMCS) in accordance with one embodiment of the present invention;

[1014] FIG. 2 shows a more detailed representation of each of the plurality of access terminals of the wireless communication system of FIG. 1 in accordance with one embodiment of the present invention;

[1015] FIG. 3 is a flow chart of a process for obtaining a radio frequency (RF) quality parameter from each of the plurality of access terminals according to one embodiment of the present invention;

[1016] FIG. 4 shows a flowchart for providing a service threshold indicator for a BCMCS service of the wireless communication system of FIG. 1 in accordance with one embodiment of the present invention; and

[1017] FIG. 5 illustrates a Service Threshold Indicator (STI) embedded in a BCMCS flow ID stream that is transmitted to the access terminals in accordance with one embodiment of the present invention.

DETAILED DESCRIPTION

[1018] Turning now to the drawings, and specifically referring to FIG. 1, a wireless communication system 100 is shown in accordance with one embodiment of the present invention. The wireless communication system 100 comprises a plurality of access terminals (AT) 105 that communicate with a plurality of base transceiver sites (BTS) 110, which are geographically dispersed to provide continuous communication coverage with the access terminals 105 as they traverse the wireless communication system 100.

[1019] According to one embodiment, the wireless communication system 100 employs a Broadcast and Multicast Service (BCMCS) for point-to-multipoint transmission of data packets to a predetermined group of access terminals 105 communicating within the wireless communication system 100. In one embodiment, the data packets provide content such as, for example, news, movies, sporting events, and the like that is transmitted from the base transceiver sites 110 over a wireless

communication link 115 to the access terminals 105. It will be appreciated that the specific type of content transmitted to the access terminals 105 may include a wide array of multi-media data (e.g., text, audio, picture, streaming video, etc.), and, thus, need not necessarily be limited by the aforementioned examples.

[1020] Each base transceiver site 110 is coupled to a base station controller (BSC) 120, which controls connections between the base transceiver sites 110 and other components of the wireless communication system 100. The base transceiver sites 110 and the base station controller 120 collectively form a radio access network (RAN) for transporting the content to the plurality of access terminals 105 that communicate within the wireless communication system 100. The base transceiver sites 110 are coupled to the base station controller 120 by communication links 125. In accordance with one embodiment, the communication links 125 coupling the base transceiver sites 110 to the base station controller 120 may take the form of a wireline E1 or T1 link. It will be appreciated, however, that the communication links 125 may alternatively be embodied using any one of a number of wired or wireless communication mediums including, but not necessarily limited to, microwave, optical fiber, and the like.

[1021] The base station controller 120 is coupled to a packet data serving node (PDSN) 140 via a Packet Control Function (PCF) for interfacing the wireless communication system 100 to a content server (CS) 160 via an Internet Protocol (IP) medium (not shown). The PDSN 140 processes the data packets for distribution to the access terminals 105 within the wireless communication system 100 under the control of a BCMCS controller 150, which may or may not have a direct connection to the PDSN 140. For BCMCS service, the base transceiver site 110 receives the stream of information from the PDSN 140 and provides the information on a designated wireless communication link 115 to the predetermined group of access terminals 105 communicating within the wireless communication system 100.

[1022] The content server 160 generates the content to be broadcast from the base transceiver sites 110 to the predetermined group of access terminals 105 that are authorized to receive the specific type of content. It will be appreciated that the base station controller 120 may also be coupled to various other types of networks, such as a public switched telephone network (PSTN), for example, to extend the communication capabilities of the wireless communication system 100. In the illustrated embodiment, the base transceiver sites 110 and the access terminals 105 operate in accordance with a code division multiple access (CDMA) scheme, such as cdma2000 1xEV-DO, for

example. It will be appreciated, however, that the wireless communication system 100 may employ various other multiple access schemes, such as time division multiple access (TDMA) and the like, without departing from the spirit and scope of the present invention.

[1023] The wireless communication system 100 enables high speed BCMCS service through the wireless communication link 115 that includes a forward broadcast shared channel (F-BSCH) capable of high data rates that can be received by a large number of access terminals 105. The term forward broadcast shared channel is used herein to mean a single forward link physical channel that carries broadcast traffic. Data may also be transmitted from the access terminals 105 to the base transceiver sites 110 through a reverse link of the wireless communication link 115. In one embodiment, the reverse link includes a signaling traffic channel and a data rate control (DRC) channel. The data rate control (DRC) channel of the reverse link may be used via a data rate request to indicate to the wireless communication system 100 a supportable broadcast data rate that may be used to broadcast the content over the F-BSCH of the forward link.,

[1024] Typically, the user of the access terminal 105 will receive content from the content server 160 by subscribing to one or more information services over the F-BSCH provided by the content server 160. To authenticate the access terminal 105 for receiving the particular content subscribed to, the BCMCS controller 150 or the content server 160 will generate a value of a Broadcast Access Key (BAK) over the wireless communication link 115. The BAK serves as a security association between the content server 160 and the group of access terminals 105 that subscribe to certain services provided by the content server 160. The process for providing this authentication for receiving particular content at the access terminal 105 using the BAK is well known to those of ordinary skill in the art. Accordingly, the specifics for this authentication process is not disclosed herein to avoid unnecessarily obscuring the present invention.

[1025] Typically, a system operator (of the wireless communication system 100, for example) will charge a user of the access terminal 105 when he or she obtains the BAK for BCMCS content that is generated by the content server 160. If the BAK has a relatively short lifetime (e.g., for a minute or a few minutes), for the purpose of pay-per-view charging for the BCMCS content, the access terminal 105 will typically tune to the BCMCS content on the F-BSCH subsequent to receiving the BAK. In some cases, however, the access terminal 105 may move to a coverage area of the wireless

communication system 100 where the radio reception of the access terminal 105 is poor for receiving a particular BCMCS content albeit the access terminal 105 may have successfully obtained the BAK over the TCP/IP session. As a result, the access terminal 105 may experience an unacceptable service quality of the BCMCS content from the content server 160 when the access terminal 105 has tuned to the F-BSCH for receiving the BCMCS content.

[1026] In another scenario, the lifetime of the BAK received by the access terminal 105 may be longer (e.g., for a month or more) to provide the access terminal 105 with particular BCMCS content generated from the content server 160. As long as the BAK is being obtained, the access terminal 105 may receive the particular BCMCS content over the F-BSCH. Even though the access terminal 105 may be able to obtain the BCMCS content over the F-BSCH, however, the content may become corrupted as it is received by the access terminal 105 when the radio reception for the access terminal 105 is deemed poor. As a result, the access terminal 105 may try to decode the corrupted BCMCS content, thus causing an unnecessary drain on the access terminal 105's battery.

[1027] In another scenario, the BCMCS content may be delivered to a group of access terminals 105 that may "playback" the BCMCS content at a later time after receiving the content. If an access terminal 105 resides in an area with poor radio reception of the wireless communication system 100, the received BCMCS content may become corrupted when being received over the F-BSCH. The access terminal 105 may request retransmission of the corrupted BCMCS content at a later time. In such a case, the unicast (i.e., point-to-point) transmission of the content may be used by the wireless communication system 100 to retransmit the particular BCMCS content that was not properly received by the access terminal 105 initially. However, if the number of access terminals 105 who desire retransmission of the particular BCMCS content becomes large, such unicast transmission of the particular BCMCS content may undesirably increase the load of the wireless communication system 100, thereby consuming the system's available resources significantly.

[1028] In accordance with the illustrated embodiment of the present invention, a service threshold indicator (STI) is employed to indicate to the access terminal 105 and its user whether the BCMCS content that is broadcast from the base transceiver sites 110 of the wireless communication system 100 may be properly received by the access terminal 105 for successful decoding thereby. That is, the use of the STI reduces the

likelihood that the BCMCS content received by the access terminal 105 may be corrupted as a result of the access terminal 105 potentially being located in an area of the wireless communication system 100 that may cause poor radio frequency (RF) reception quality by the access terminal 105. In one embodiment, the STI may be provided in the form of an 8-bit code that is representative of one or more minimum RF quality parameters, such as a frame error rate (FER), ratio of the average transmit energy to the total transmit power spectral density (E_c/I_o), received signal strength indicator (RSSI), or receive (Rx) power of the access terminal 105 over the wireless communication link 115. In one embodiment, if the minimum RF quality parameters represented by the STI exceed the RF quality parameters that are currently experienced by the access terminal 105 over the wireless communication link 105, then the access terminal 105 is prevented from tuning to the F-BSCH because the likelihood of receiving corrupted BCMCS content is increased as a result of the minimum RF quality parameters of the STI not being achieved by the access terminal 105.

[1029] Referring now to FIG. 2, a block diagram of the access terminal 105 is provided in accordance with one embodiment of the present invention. In one of its most simplest forms, the access terminal 105 comprises a receiver 205 for tuning to the F-BSCH of the wireless communication link 115 and for receiving the BCMCS content transmitted from the base transceiver sites 110 over the F-BSCH. A transmitter 210 may transmit data to the base transceiver site 110 with which the access terminal 105 is communicating. The access terminal 105 also comprises a controller 215 for controlling the overall operation thereof and a memory 225 for storing data. In the illustrated embodiment, the access terminal 105 further comprises an RF quality analyzer 220 for providing a qualitative assessment of RF communication over the wireless communication link 115 between the access terminal 105 and the base transceiver site 110 with which the access terminal 105 is communicating. In accordance with one embodiment, the RF quality analyzer 220 may determine the frame error rate (FER) of communication over the F-BSCH between the access terminal 105 and the base transceiver site 110 and generates an RF quality parameter indicative thereof. The RF quality analyzer 220 may further determine the ratio of the average transmit energy to the total transmit power spectral density (E_c/I_o), received signal strength indicator (RSSI), or the receive (Rx) power of the access terminal 105 as RF quality parameters of the wireless communication link 115. It will be appreciated, however, that various other RF quality parameters may be ascertained by the analyzer

220 to qualitatively assess the F-BSCH between the access terminal 105 and the base transceiver site 110, and, thus, need not necessarily be limited to the aforementioned examples. Additionally, the analyzer 220 may determine any combination (i.e., more than one) of the RF quality parameters provided above.

[1030] In accordance with one embodiment, the RF quality parameter(s) may be determined automatically by the RF quality analyzer 220 on a periodic basis. That is, the RF quality analyzer 220 may sample the RF communication quality of the F-BSCH after the expiration of a predetermined time interval, such as every five seconds, for example. It will be appreciated, however, that the analyzer 220 may alternatively determine the communication quality of the F-BSCH upon the occurrence of a predetermined event. In one embodiment, the predetermined event may be receiving a control signal from the radio access network of the wireless communication system 100 to have the analyzer 220 of the access terminal 105 determine the quality of the F-BSCH between the access terminal 105 and the base transceiver site 110 with which it is communicating. In another embodiment, the predetermined event for triggering the analyzer 220 to sample the RF communication quality may be an explicit action performed by the access terminal's user, such as the user depressing a key (not shown) on the access terminal 105, for example. It will be appreciated that various other events may cause the analyzer 220 to determine the quality of the forward broadcast shared channel, and, thus, need not necessarily be limited to the aforementioned examples. The access terminal 105 may further be configured with a display screen 230 to visually indicate to the user whether the access terminal 105 may or may not adequately receive the BCMCS content over the F-BSCH based upon determining the RF quality parameters by the analyzer 220.

[1031] It will be appreciated that the access terminal 105 illustrated in FIG. 2 is provided in one of its most simplest forms. Accordingly, the access terminal 105 may include additional components for providing a variety of other functions without departing from the spirit and scope of the present invention. Additionally, it will be appreciated that the functionality of the various components of the access terminal 105 may be combined into a single component. For example, the functionality performed by the RF quality analyzer 220 may be integrated with the controller 215 without departing from the spirit and scope of the present invention.

[1032] Referring now to FIG. 3, a process performed by each access terminal 105 of the wireless communication system 100 is provided in accordance with one

embodiment of the present invention. At block 305, the access terminal 105 obtains BCMCS content information such as BCMCS Flow ID and minimum RF quality parameter(s) (herein "RF quality requirement(s)") of the F-BSCH designated by the STI from the BCMCS controller 150 via an out of band mechanism, such as a hypertext transfer protocol (HTTP), for example. In response to receiving this information, the access terminal 105 stores the RF quality requirement(s) that indicate to what degree or magnitude of communication quality the F-BSCH is needed to possess (as designated by the STI value) in the memory 225 along with the STI value at block 310. According to the illustrated embodiment, the STI value is 8-bits and indicates an integer value for designating the minimum RF quality requirement(s) for properly receiving particular BCMCS content over the F-BSCH for successful decoding by the access terminal 105. For example, the RF quality requirements to decode particular BCMCS content by the access terminal 105 may be to have an FER of less than 1%, an E_c/I_o of greater than -14 dB, and an Rx power of greater than -98 dB. These minimum quality requirements imposed by the system operator of the wireless communication system 100 may be represented by an 8-bit STI value of "0000 0001," for example. Alternatively, the minimum quality requirements may be to have an FER of less than 2% and an E_c/I_o of greater than -12 dB, for example. These latter quality requirements may be represented by an STI value of "0000 0005," for example. It will be appreciated that the STI value need not necessarily be limited to being 8-bits long, but may include fewer or more bits. Additionally, it will be appreciated that the RF quality requirements may include various other communication quality measurements, and, thus, need not necessarily be limited to the aforementioned examples. Moreover, the STI value may designate one or more minimum RF quality requirements.

[1033] At block 315, the access terminal 105 determines the current RF quality parameter(s) of the F-BSCH by the RF quality analyzer 220 upon the occurrence of a predetermined event. In accordance with one embodiment, the predetermined event may be for the analyzer 220 to determine the communication quality of the wireless communication link 115 on a periodic basis, such as every certain number of seconds, for example. In an alternative embodiment, the predetermined event may be for the receipt of a control signal by the access terminal 105 that was generated from the radio access network of the wireless communication system 100, which instructs the analyzer 220 within the access terminal 105 to determine the communication quality of the F-BSCH of the wireless communication link 115. In another embodiment, the user of the

access terminal 105 may manually trigger the RF analyzer 220 to ascertain the current RF quality parameter(s) by the actuation of a key on the access terminal 105, for example.

[1034] Once the RF quality analyzer 220 determines the RF quality parameter(s) of the F-BSCH, the controller 215 compares the current RF quality parameter(s) from the analyzer 220 to the stored RF quality requirement(s) associated with the STI value at block 320. If the controller 215 determines that the RF quality parameter(s) determined by the analyzer 220 are below the RF quality requirement(s) as designated by the stored STI, the controller 215 prevents the receiver 205 of the access terminal 105 from tuning to the F-BSCH (and/or receiving the BAK) at block 325.

[1035] Turning now to FIG. 4, a process for providing a service threshold indication for a Broadcast and Multicast Service (BCMCS) of the wireless communication system 100 is provided in accordance with one illustrative embodiment of the present invention. At block 405, the BCMCS controller 150 generates a service threshold indicator (STI) value to designate a minimum service communication threshold for receiving particular BCMCS content by the access terminal 105 that is transmitted over the F-BSCH by the base transceiver site 110. In one embodiment, the RF quality requirement(s) designated by the STI value may be based on a minimum frame error rate (FER) over the F-BSCH of the wireless communication link 115 between the access terminal 105 and the base transceiver site 110. The RF quality requirement(s) designated by the STI value may further be based on a ratio of the average transmit energy to the total transmit power spectral density (E_c/I_o), received signal strength indicator (RSSI), or the receive (Rx) power of the access terminal 105, and the like. It will be appreciated that the RF quality requirement(s) may be based on a variety of other communication quality factors of the F-BSCH and, thus, need not necessarily be limited to the aforementioned examples.

[1036] At block 410, the BCMCS controller 150 concatenates the STI value determined with each Flow ID of the BCMCS flow ID stream transmitted on the overhead channel between the base transceiver site 110 and the access terminal 105 as illustrated in FIG. 5.

[1037] At block 415, the access terminal 105 receives the BCMCS flow ID stream and STI value from the base transceiver site 110 communicating therewith. At block 420, the access terminal 105 obtains the RF quality requirement(s) using the STI value received with the BCMCS flow ID from the memory 225 of the access terminal 105. At

block 425, it is determined if the current (i.e., measured) RF quality parameter(s) that are determined by the RF quality analyzer 220 are lower than the RF quality requirement(s) associated with the STI value in the memory 225 of the access terminal 105. If it is determined that the measured RF quality parameter(s) at the access terminal 105 are not lower than or equal to the RF quality requirement(s) in the memory 225, then the access terminal 105 acquires the BAK and/or tunes to the corresponding F-BSCH for receiving the BCMCS content at block 430.

[1038] If, however, the measured RF quality parameter(s) are lower than the RF quality requirement(s) designated by the STI value in the memory 225, the process continues to block 435, where it is determined if the BAK has already been acquired by the access terminal 105. If the BAK has not yet been accessed by the access terminal 105 in block 435, the access terminal 105 is prevented from acquiring the BAK at block 440 and an "out of coverage" indication may be displayed on the display screen 230 of the access terminal 105. If, however, the BAK has been acquired by the access terminal 105 at block 435 (or the BAK is not required for receiving the BCMCS content), the process continues to block 445, where the access terminal 105 prevents tuning to the F-BSCH for receiving the BCMCS content and an "out of coverage" indication may be displayed on the display screen 230 of the access terminal 105.

[1039] Those of skill in the art would understand that information and signals may be represented using any of a variety of different technologies and techniques. For example, data, instructions, commands, information, signals, bits, symbols, and chips that may be referenced throughout the above description may be represented by voltages, currents, electromagnetic waves, magnetic fields or particles, optical fields or particles, or any combination thereof.

[1040] Those of skill would further appreciate that the various illustrative logical blocks, modules, circuits, and algorithm steps described in connection with the embodiments disclosed herein may be implemented as electronic hardware, computer software, or combinations of both. To clearly illustrate this interchangeability of hardware and software, various illustrative components, blocks, modules, circuits, and steps have been described above generally in terms of their functionality. Whether such functionality is implemented as hardware or software depends upon the particular application and design constraints imposed on the overall system. Skilled artisans may implement the described functionality in varying ways for each particular application,

but such implementation decisions should not be interpreted as causing a departure from the scope of the present invention.

[1041] The various illustrative logical blocks, modules, and circuits described in connection with the embodiments disclosed herein may be implemented or performed with a general purpose processor, a digital signal processor (DSP), an application specific integrated circuit (ASIC), a field programmable gate array (FPGA) or other programmable logic device, discrete gate or transistor logic, discrete hardware components, or any combination thereof designed to perform the functions described herein. A general purpose processor may be a microprocessor, but in the alternative, the processor may be any conventional processor, controller, microcontroller, or state machine. A processor may also be implemented as a combination of computing devices, e.g., a combination of a DSP and a microprocessor, a plurality of microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration.

[1042] The steps of a method or algorithm described in connection with the embodiments disclosed herein may be embodied directly in hardware, in a software module executed by a processor, or in a combination of the two. A software module may reside in RAM memory, flash memory, ROM memory, EPROM memory, EEPROM memory, registers, hard disk, a removable disk, a CD-ROM, or any other form of storage medium known in the art. An exemplary storage medium is coupled to the processor such the processor can read information from, and write information to, the storage medium. In the alternative, the storage medium may be integral to the processor. The processor and the storage medium may reside in an ASIC. The ASIC may reside in a user terminal. In the alternative, the processor and the storage medium may reside as discrete components in a user terminal.

[1043] The previous description of the disclosed embodiments is provided to enable any person skilled in the art to make or use the present invention. Various modifications to these embodiments will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other embodiments without departing from the spirit or scope of the invention. Thus, the present invention is not intended to be limited to the embodiments shown herein but is to be accorded the widest scope consistent with the principles and novel features disclosed herein.